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Vision and Aging Laboratory
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Report on Visual Aging and Research Program

D. Kline
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Project 1: Aging, Visual Persistence and Spatial Frequency

With adult aging there is a well-demonstrated slowing in the speed of visual processing. This decline in temporal resolution has often been attributed to an increase in the persistence of a visual stimulus in the nervous system of older persons. The major shortcoming of this notion, however, is that although it presents a reasonably good description of age-related visual slowing, it does not identify the location in the nervous system where the persistence is occurring nor the mechanisms underlying it. This research project has investigated the possibility that the age-related slowing in visual perception is due to a disproportionate decline in one of the visual system's two channel types. The "sustained" visual channels respond optimally to stationary, high contrast finely-detailed (i.e., high spatial frequency) stimuli and are thus well-suited to pattern perception. The transient channels respond best to large (low spatial frequency), low-contrast stimuli which are changing (e.g., flickering or moving) and are responsible for detection of motion or change. The transient/ sustained shift "hypothesis that we have investigated in this project, holds that the transient channels are less effective in old age than are the sustained ones, thus explaining the loss of temporal resolving power in the visual system.

Young and old adult observers were asked to detect temporal interruptions that occurred in black and white vertical bar patterns of varied spatial frequency (i.e., of different bar width). As hypothesized, the age differences were prominent for the (low spatial frequency); for the narrow (high spatial frequency) bar patterns, to which the sustained channels respond, there was no age difference at all (please see Figure). These results support the hypothesis that a decline in transient visual channel effectiveness accounts for at least some of the visual slowing in old age. Practically, these results suggest that visual tasks with moving or quickly flashing stimuli would be likely to put older persons at a disadvantage. In addition, these findings suggest the value of including a "dynamic" component in vision tests which are used for screening persons carrying out dynamic tasks (e.g., driving, piloting).

Project 2: Light Level Aging and Acuity

As a result of changes in the eye, particularly the increased opacity of the lens and a smaller pupil size, the retina of an older person receives significantly less light than its younger counterpart. As a result, older persons are likely to experience difficulty in carrying out tasks under conditions of low light (e.g., night driving, seeing in a dimly-lit restaurant). In addition, because of the relatively low light level in most commercially-available vision testing machines (such are used in Departments of Motor Vehicles), the acuity of many older persons (e.g., drivers) is likely to be underestimated in regard to

daytime conditions. This, in turn could result in the inappropriate restrictions or even inappropriate loss of privileges (e.g., restriction or even loss of driving license).

We are currently assessing acuity for high and low contrast targets under various levels of illumination for young, middle-aged and elderly observers. Preliminary results suggest that older persons do experience disproportionate difficulty under conditions of low illumination and low contrast. In addition, it appears likely that the daytime visual acuity of older drivers is not validly assessed by most commercially-available vision testers.

Project 3: Aging the Visual Channels and Brain Lateralization

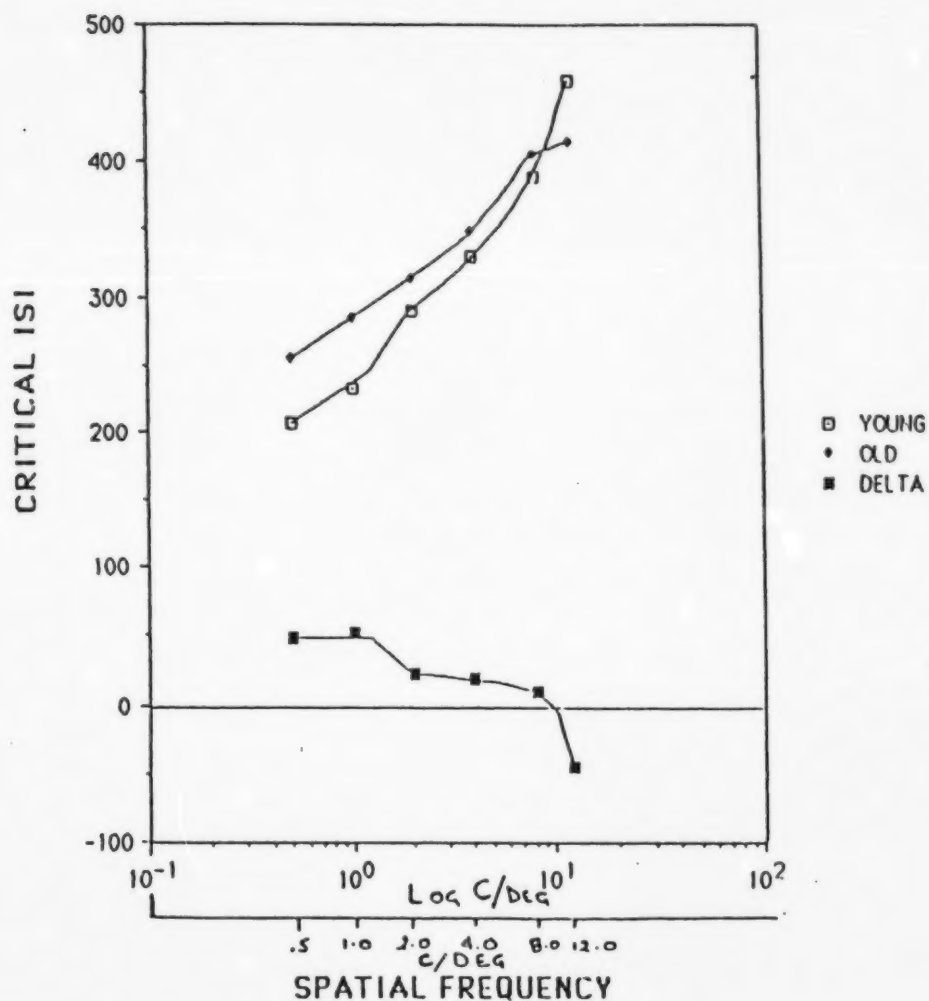
It has been suggested that the functions associated with the right hemisphere of the brain diminish in effectiveness with age at a faster rate than those associated with the left hemisphere. In the visual system the right half of the brain is most immediately responsible for the perception of objects and events in the left half of the world. Clearly, if there are changes in ability to process spatial information from the left, it could have a significant effect on carrying out tasks where processing information from the whole visual field is important (e.g., driving, way-finding, t.v. and motion picture viewing, etc.)

This project is comparing young and old observers in regard to estimation of object size and visual illusion effects for both the right and left halves of the brain. Data gathering is almost completed, and they suggest that size judgement and illusory

effects are greater in right vs left half of the brain, especially for older observers. Future research will be needed to indicate to what degree these changes affect visual functioning on important everyday tasks.

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PERSISTENCE = f(AGE, SPATIAL FREQUENCY)



These data suggest that the low spatial frequency temporal detection mechanisms are those particularly affected by aging of the visual system. This difference is diminished, or is even reversed when a comparison is made of the high spatial frequency mechanisms. It is not clear whether the latter result reflects an actual superiority in older age of the so-called sustained channels, or alternatively, their relative disinhibition resulting from transient channel decline. In either case, however, it is clear that age differences in temporal resolution vary considerably as a function of the spatial